manufacture of artificial visualisations; and the hat feat just narrated falls within the same category.

In working the rich mine which Mr. Galton's genius has discovered, I hope he will explore the vein of chess without the chess-board. As efforts of memory, such performances are as surprising as the numerical feats of Colburn and Bidder. And they notably differ from them in that the highest development is reached, not by young boys, but by men of mature years, who, as players over the board, have reached the front rank. The writer (in last year's *Chess Player's Chronicle*) attempted to give a rough estimate of the number of moves and positions possible at chess. They are of course practically illimitable; and with this fact in mind it is easy to form an idea of the difficulty of playing *twelve* games blindfold against very strong antagonists. This task, however, is often performed by Messrs. Zukertort and Blackburne, beyond question in England, and probably in the world, the greatest adepts in this branch of chess-play. It would be highly instructive to learn by what process, in so far as it is a conscious and describable one, these feats are achieved. If Mr. Galton takes the matter up, no doubt he will, with his usual skill, throw a flood of light upon the subject.

EDWYN ANTHONY

Riggs's Hotel, Washington, March 29

Meteor

A LARGE and brilliant meteor was seen here at 8.25 p.m. on the 7th inst. It appeared a little below Zeta Tauri, and travelled very slowly southwards in a line nearly parallel to the horizon, traversing a space of about 50°.

The meteor rapidly increased in brilliancy, and is described as many times brighter than Venus, until near the end of its course, when it diminished in size. No trail was seen, although the meteor appeared to smoke.

SYD. EVERSHED

Wonersh, Guildford, April 12

Carnivorous Wasps

A SUMMER or two ago I observed a number of dead flies, blue-bottles, humble-bees, and hive-bees on a certain part of one path in my garden; though the dead insects were removed every day, yet a fresh collection was seen every morning, the cause of death remaining unknown for several days. One morning I was earlier than usual in the garden, and I saw a number of wasps attacking flies and bees in their flight, biting and twisting their wings, and ultimately killing their victims on the ground.

The garden was at the time full of flowers, and the wasps appeared to be waiting in ambush for the flies and bees as they came over a low wall into the garden. Sometimes the wasps would bite the wings entirely off their victims, and they soon after appeared to be sucking the juices of the flies from the joint between the head and thorax.

WORTHINGTON G. SMITH

"Who are the Irish?"

WILL you permit a few words of reply to your notice of "Who are the Irish?"

Grateful to your critic for pointing out some hastily-written sentences, I am surprised he failed to see the real object of the little book. This was to show in a popular rather than a scientific way the folly of that *race hatred*, arising from the assumption that Irish are Celts and English are Saxons.

It was not necessary to cite French authorities on the Celtic question there, though they appear in the forthcoming pamphlet on "Who are the Scotch?" As for my supposed absurd remarks about Basques and Dark Irish, I only quoted the opinions of the learned Prof. Huxley. My simple and honest desire was to promote peace and goodwill between two peoples, more closely related than the factious and contentious care to believe.

JAMES BONWICK, AUTHOR OF "WHO ARE THE IRISH"

Acton, E., March 24

A LEAF FROM THE HISTORY OF SWEDISH NATURAL SCIENCE [1]

III.

IN a yet higher degree than fluor spar, phosphorus attracted attention through its property of being self-luminous in darkness in consequence of a slow combustion. This substance was accidentally discovered, as I have already mentioned, at the close of the sixteenth century, at Hamburg in the course of experiments made by the ruined alchemist, Brand, with a view to produce the philosopher's stone by the dry distillation of urine which had been evaporated to dryness. The raw material was not abundant, the process of manufacture uncertain, and phosphorus, which is now sold at about 7*s.* 6*d.* per kilogram, was worth many times its weight in gold. Soon after the physician Bernard Albinus discovered that the same substance could also be produced from the ashes of certain plants, but its general occurrence in nature (in the bones of animals and in the mineral kingdom) was first pointed out by Scheele and Gahn, who, during Scheele's stay in Stockholm (1768-70), are believed to have simultaneously made this important discovery.[1] It forms the proper starting point of our knowledge of this substance, of such extraordinary importance in the economy of nature, so indispensable in scientific agriculture, in medicine, and in numberless branches of modern industry.

In attempting to discover the cause of cold-shortness in iron, Bergman and the German Meyer believed that they had discovered almost simultaneously that it was caused by the iron being alloyed with a brittle and easily fusible metal, for which Meyer proposed the name *hydrosiderum*. Soon after, however, Meyer himself and Klaproth showed that a metal completely similar was produced by fusing together iron and phosphoric acid—the latter distinguished chemist expressly declaring that the *analytical* proof of this was difficult to carry out. The year after, however, Scheele succeeded in producing phosphorus in a very ingenious way from cold-short iron. We are thus under a great obligation to him for a very important contribution to scientific metallurgy.

As I have already stated, Brandt proved, about 1730, that the regulus of arsenic ought to be considered as a peculiar semi-metal, whose proper "kalk" was arsenious acid. If we except Macquer's discovery of arseniate of potash, our knowledge of this important and dangerous substance made little progress during the following decades, until Scheele in 1775 published in the *Transactions* of the Swedish Academy of Sciences his remarkable, and in this field epoch-making work "On Arsenic and its Acid." Scheele introduced to our knowledge arsenic acid and a number of its salts, and besides discovered that it gave with zinc a gas previously unknown, which contained "combustible air" and arsenic. This gas (arseniuretted hydrogen) is exceedingly poisonous, and experiments with it forty years after its discovery cost the German chemist Gehlen his life. It appears to be this gas which is given off in rooms where the paper-hangings contain arsenic. This work of Scheele's came to be of great theoretic importance by his sharp glance immediately noting that the white arsenic and the new arsenic acid were different degrees of oxidation, or as it was then expressed, different "stadia of dephlogistication" of the same metal. Long before Davy's discovery of potassium and sodium, Berzelius' of calcium and silicium, and Wöhler's of aluminium, Scheele appear to have had a clear insight into the relationship of the earths to metallic oxides.[2]

[1] Translated from a paper by Prof. A. E. Nordenskjöld of Stockholm. Continued from p. 541.

[1] The first account of this discovery is found in a note of two lines in Scheele's paper on fluor spar to this effect: "That the earth in bone and horn is lime saturated with *acidum phosphori* is newly discovered." (*Trans. Acad. Sc.* 1771). The discovery was ascribed by Bergman in his edition of Scheffer's Chemistry, at one place to Scheele, and at another to Gahn. The facts of the case are cleared up in Wilcke's biography of Scheele He had in the spring of 1770 mentioned to Gahn that he had found in burned hartshorn lime combined with a substance unknown to him, on which Gahn examined the "animal earth by means of the blow-pipe, and found it be composed of lime combined with phosphoric acid." Scheele at first doubted Gahn's statement, until in the summer of the same year at Upsala he for the first time made phosphorus from burned bones.

[2] All metallic "kalks," indeed all earths are distinct acids, whose difference depends on different proportions of phlogiston. In a letter to Hjelm Scheele says:—"The discovery of ferric acid is reserved for chemists, not earlier than the coming century, when we labour in the Elysian fields" Ferric acid was discovered in 1840 by Fremy.

Of still greater importance than the discovery of arseniuretted hydrogen was Scheele's discovery of sulphuretted hydrogen. Long before, indeed, it had been observed that when sulphides were decomposed an ill-smelling gas was given off which blackened silver (Boyle, 1663), was combustible, poisonous, and capable of being absorbed by water, to which it communicated its taste and smell (Rouelle and Meyer, 1754-1774), but no further examination of the nature of the gas had been carried out, and it was generally considered to be impure hydrogen. In 1777 Scheele isolated this gas, also a previously quite unknown fluid compound of sulphur and hydrogen, and gave a correct statement of their composition. The formerly neglected ill-smelling gas now became the subject of comprehensive researches by Bergman, Kirwan, Berthollet, &c. Its chemistry was completely cleared up, and it became an *indispensable* assistant in every laboratory and nearly every chemical manufactory.

At various Saxon and Bohemian mines there are found along with tin ore two kinds of minerals, whose weight early attracted the attention of the miners, and which, seeing no metal could be smelted from them, were considered as "wild" ores of tin. We find them described in detail for the first time in the Mineralogies of Wallerius and Cronstedt, and Cronstedt expressly states that they do contain tin as a proper constituent. One of these minerals, which was afterwards called *scheelite*, but at first by Swedish mineralogists *tungsten*, was found about 1770 in small nodules in the Bispberg mines in Dalecarlia, and was in consequence examined by Scheele. He immediately discovered that this mineral, which had been previously examined without success by so many chemists, was a compound of lime with a new metallic acid.

Bergman supposed that the chemist had here not only to do with a new acid, but also with the acid of a new metal, a supposition which was immediately confirmed by the Spanish chemists, the brothers Don Fausto [1] and Don Juan José d'Elhuyar. This metal is now called by different names—wolfram by Swedes and Germans, scheele and tungstène by the English and French. The last name is derived from tungsten, that given by the miners at Bispberg to the mineral from which the acid was first produced—a derivation perhaps difficult enough for a philologist to clear up in case it comes in question to determine the root of the Frenchman's *acid tungstique*.

The paper "On the Constituents of Tungsten" was published in 1781. In 1778 and 1779 Scheele inserted in the *Transactions* of the Academy "Researches on the Blacklead Molybdæna" and "Researches on the Blacklead Plumbago," of which one paper enriched science with a new simple substance, *molybdenum*, and the other taught us the true chemical nature of a mineral long used and unsuccessfully examined by many chemists. Both these researches have been of immense importance for the metallurgy of iron, the former through the splendid reaction (discovered by L. Svanberg and H. Struve in 1848) which phosphoric acid gives with molybdic acid, and which forms an indispensable means for every metallurgist for discovering the least trace of phosphorus in iron, the latter by the discovery that graphite enters as a constituent into various sorts of iron. Some lines on this point in Scheele's paper suggested the investigations of Bergman, Rinman, Monge, Berthollet, Guyton de Morveau, and others on the chemical difference between pig iron, bar iron, and steel, which alone rendered possible the development of the iron industry to the advanced position which it occupies in this era of steam-engines and railways.

Scheele further enriched our knowledge of the mineral acids by his discovery of nitrous acid and his examination of the products of the decomposition of nitric acid. It is said that an observation connected with this subject first led to his intimate acquaintance with Bergman, and his last scientific communication relates to this subject, inasmuch as shortly before his death he informed Wilcke by letter that nitric acid under the action of sunlight gives off combustible gas.

Want of space compels me to pass over many less considerable, but nevertheless often very important communications by Scheele. I have yet, however, to give account of his two greatest and most important labours.

The first of them was published in the *Transactions* of the Swedish Academy of Sciences for 1774, under the modest title, "On Brunsten, or Magnesia, and its Properties." Brunsten (black oxide of manganese) and various allied species of minerals are first mentioned in the fourteenth century by Albertus Magnus under the name of "magnesia," but they had long before that time been employed in the arts. Afterwards we find those minerals often referred to by mineralogists and chemists, and many unsuccessful attempts were made to ascertain their composition.

Soon after his coming to Upsala Scheele undertook, at the suggestion of Bergman, to try his strength on this difficult substance. Scheele showed at first that brunsten contained a peculiar base combined with a substance which had a strong affinity for combustible bodies. The properties of the new base were carefully investigated, also its relations to a large number of reagents. From these researches Scheele drew the conclusion that we had here to do with a metallic oxide—a view which was soon after confirmed by Gahn through direct reduction with charcoal. Chemistry was thus enriched with a new metal, *manganese*, which has long been very extensively used in the arts, among other applications in the manufacture of Bessemer iron. Scheele observed further that a solution of black oxide of manganese in muriatic or nitric acid when sulphuric acid was added gave a scanty white precipitate. It is distinctive of Scheele's chemical researches that he never neglected to investigate the cause of even the most inconsiderable occurrences in the course of the work, and many of his most important discoveries originated just from the attention he bestowed upon circumstances which would probably have escaped the notice of other chemists. The inconsiderable white precipitate led to the knowledge of a new earth, *baryta*, which soon after was found by Gahn in a mineral of very common occurrence, heavy spar. The salts of baryta are now indispensable in every laboratory as the means of discovering and separating sulphuric acid, and extensive branches of industry are grounded on the multitudinous applications which have long ago been found for this earth.

When black oxide of manganese was treated with muriatic acid Scheele observed that the dark brown solution, obtained by cold dissolving, when heated gives off a strongly-smelling gas, which from its colour was afterwards named *chlorine*. This was the third simple substance to whose discovery the examination of black oxide of manganese gave occasion. It is scarcely possible completely to sketch the enormous influence which the discovery of chlorine exerted on the development of inorganic, but perhaps still more of organic chemistry; and on all the branches of human knowledge and human industry which in any way are related to chemical science. As a single instance it may be observed that at that time there was no other method known of bleaching cotton cloth than by exposing it for a length of time to the action of sunlight. Every cotton-spinning or weaving manufactory therefore required extensive meadows for bleaching its wares. But land is dear in England, and on this account the branch of industry in question was about to migrate from that country, where in the middle

[1] Don Fausto afterwards became Minister of State in Spain. The two brothers studied chemistry for a time under Bergman at Upsala, and visited Scheele at Köping. These two distinguished Spaniards' account of this visit is the only information we now possess regarding Scheele's laboratory and home life at Köping

of the eighteenth century it had begun to develop itself on an enormously great scale, to lands where ground could be obtained at a cheaper rate. In his first research on chlorine Scheele observed its bleaching property, which was carefully investigated by him, only however for theoretical, not for practical purposes. But ten years afterwards the discovery was practically applied by the French chemist Berthollet, who showed that manufacturers possessed in chlorine an invaluable means of giving cloth the desired whiteness by a simple chemical treatment within the manufactory itself. Now for the first time was it possible for the cotton industry to attain the enormous development, the immense social and political importance which the nineteenth century has witnessed. Chloroform and chloral, &c., are obtained by the action of chlorine on organic substances; by the action of chlorine on lime and potash are obtained chlorides and chlorates—all substances of incalculable importance for theoretical and practical chemistry, for medicine and the arts. Thus in the history of the natural sciences one discovery is linked with another, and the new truth which to-day seems devoid of importance to-morrow becomes a lever for advancing the happiness and well-being of the million.

The second of the works in question is separately printed, first in German, with the title, "Carl Wilhelm Scheele's, d. königl. Schwed. Acad. d. wissenschaft. Mitgliedes, chemische Abhandlung von der Luft und dem Feuer. Nebst einem Vorbericht von Torbern Bergman, Chem. und Pharm. Prof. und Ritter, verschied. Societ. Mitglied, Upsala und Leipzig," 1777.[1] In the introduction, dated 13th July, 1777, Bergman says that the work in question had been ready nearly two years, though various circumstances had delayed its printing, and in a letter to Bergman, preserved in the Library at Upsala, Scheele complains bitterly of the publisher Svederus' procrastination. Various of the most important observations recorded in this work had been already made during the examination of the black oxide of manganese (1771-1774). From all this it follows that Scheele's discovery of oxygen, of nitrogen,[2] and of the composition of atmospheric air took place simultaneously with Priestley's, and that both these investigators reached the same goal by widely separated paths. Lavoisier too is often, but incorrectly, named as the discoverer of oxygen. On the other hand, it was *his* genius that laid Priestley's and Scheele's discovery as the foundation for the new and still existing fabric of knowledge. While Scheele and Priestley,[3] who made the fundamental discovery on which the new theory was founded, remained at the old stand-point, this discovery was estimated by Lavoisier at its true value, and it thus became a veritable turning-point in the history of science. But the numerous ingenious experiments by which Scheele proved the propositions advanced by him at the very beginning of his treatise on "Fire and Air," *that the air is composed of two different gases*, still to this day are the corner-stones in the new fabric of science, and most of them are still repeated in every series of lectures on the subjects in question.

Death broke off Scheele's scientific path the same year that the work was printed in which Lavoisier distinctly rejected the phlogiston theory, and three years before the first edition of his "Traité Élémentaire de Chimie, présenté dans un Ordre Nouveau, et d'après les Découvertes Modernes" appeared. If a prolonged activity had been granted him, if he had made acquaintance not only with isolated propositions from the new theory, but with the fully-developed and completed system, would he have adopted the new theory, and with it as a starting-point gone forward to new and splendid victories in the field of research, or would he, like Priestley, have obstinately stood by the old views? To this question no positive answer can of course be given. But the whole direction of Scheele's activity as a man of science tells in favour of the former alternative, and even much in his peculiar theories which, if we except his attempt to include heat among chemical substances, have many points of contact with current ideas. One thing in any case is certain. He has done enough to earn a place in the first rank of the men of science of all times and of all lands, and his name shall always form one of the grandest memories of his native country.

[1] Most of Scheele's works were first printed in the *Transactions* of the Swedish Academy of Sciences, but were immediately after translated into foreign languages. After his death his collected works were published in Latin under the title "Opuscula Physica et Chemica," Lipsiæ, 1788-89. His short papers, in which important discoveries are often stated and *proved* in a few lines, are complete masterpieces, not only in respect of their contents, but also of their form and mode of exposition. "Ses mémoires sont sans modèle comme sans imitateurs!" (Dumas' "Philosophie Chémique," p. 96.)

[2] The Scotch physician Daniel Rutherford has also great credit in connection with the discovery of nitrogen. He showed in 1772 that a species of gas, which could not maintain combustion, remained after the carbonic acid was withdrawn by means of a solution of caustic potash from the air expired by animals. Rutherford however did not carry out any further investigation of the nature of this gas.

[3] Priestley says in his last work, "Mr. Scheele's discovery was certainly independent of mine, though I believe not made quite so early."

THE UNITED STATES WEATHER MAPS, APRIL TO JULY, 1878

THIS week we have the pleasure of presenting our readers, by the courtesy of General Myer, with the International Weather Map for July 1878, showing for that month the mean pressure, temperature, force, and prevailing direction of the wind. This is the fourth consecutive number of the series, which began with April of that year, and may be regarded as completing the record of the great outstanding features of those changes which characterised the weather of the northern hemisphere in its transition from the spring to the summer of 1878.[1] We shall here chiefly consider the departures from the averages deduced from the curves and figures of the Weather Maps, seeing that these well represent the great seasonal movements of the atmosphere, together with those meteorological conditions which rule the changes of weather occurring in the different regions of the globe on which the welfare and prosperity of nations so intimately depend.

The map for April showed very large deviations from the average atmospheric pressure in all quarters of the globe. Pressure was under the average over North America, Greenland, the Atlantic to south of Iceland, the north of Africa, over Europe south of a line drawn from the north of Scotland to the Sea of Azov; over the valley of the Obi and southwards to lat. 40°; over New Zealand and Australia, and northward to the Philippines; and probably also over a large part of the Indian Ocean, including Mauritius and the eastern part of South Africa. Elsewhere pressure was in excess of the average, but most markedly over the north and east of Europe, and the whole of Asia had a pressure above the normal, except the narrow patch already referred to in the extreme west of Siberia and Turkistan.

Of these disturbances in the distribution of the earth's atmosphere, by far the most remarkable was the depression in the heart of the Atlantic, midway between Spain and New York, which amounted nearly to half an inch. Round and in upon this area of low pressure the wind blew in the usual way, bringing warmth to the region lying to eastward and cold weather to regions lying to westward. On proceeding westward pressure rose, till on the coast of the United States it was only about the sixth of an inch below the normal; but proceeding further in a north-westerly direction through the region of the Lakes, the depression gradually again deepened, till near Lake Winnipeg it fell to full a quarter of an inch below the average. The result to the States was an unusual prevalence of southerly winds, a large rainfall for this spring month, and a temperature everywhere high for the season, rising in the N.W. States to 10°·6 above the average.

[1] These Weather Maps have appeared in NATURE as follows:—April, No 535, May, No. 538 and June, No. 543.